

# **The Elbow and Radioulnar Joints (Elbow Complex)**

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## **Objectives**

After studying this topic, the students will be able to:

1. Identify the structures of the elbow and the forearm, including joint type, articular shape, and the surrounding tissues.
2. Describe joint motions occurring at the elbow, including movements, muscle actions, and factors affecting elbow motions and stability.
3. Understand the stability mechanism of the elbow complex and the possible mechanisms of injury.

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## Functions of the elbow complex

Two major functions of the extremity joints are mobility and stability. The functions of the elbow joints are to:-

- Add mobility of hand in space by;
  - shortening and/or lengthening the arm
  - rotating the forearm
  - combination of the above both
- Provide control and stability;
  - for skilled hand motions
  - for forceful upper extremity motions

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## Structure of the Elbow Complex (Bones)

The osseous segments of the elbow complex are:

- Humerus (distal part)
- Ulna (proximal part)
- Radius (proximal part)

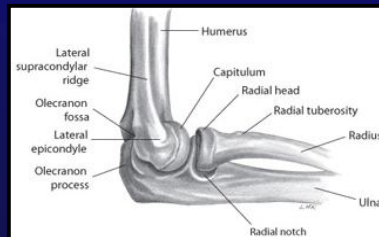


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## Bony landmarks

- Key bony landmarks for elbow
  - Olecranon process
  - Coronoid process
  - Radial tuberosity
- Key bony landmarks for wrist & hand muscles
  - medial epicondyle
  - lateral epicondyle
  - lateral supracondylar ridge



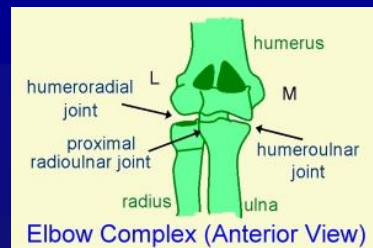
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## Joint Structure of the Elbow Complex

Joints at elbow complex are:

- Humeroulnar joint (HUJ)
- Humeroradial joint (HRJ)
- Proximal radioulnar joint (prox. RUJ)



Note :

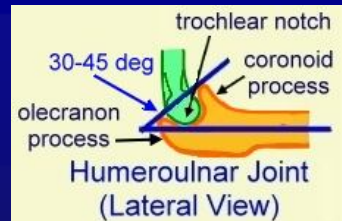
- The above three joints are enclosed in the same joint capsule

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# Humero-ulnar joint

- **Proximal component: humerus**
  - Trochlea (hourglass-shaped)
  - olecranon fossa
  - coronoid fossa
  - Coronoid process
- **Distal component: ulna**
  - trochlear fossa (saddle-shaped)
  - coronoid process
  - olecranon process
- **joint type**
  - Hinged or modified hinged
- **motion :**
  - **elbow flexion/ extension**

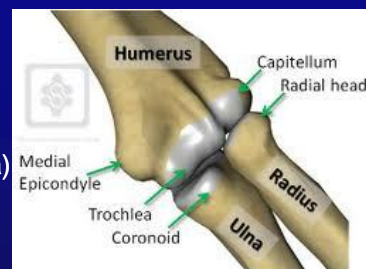


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# Humero-radial joint

- **Proximal component: humerus**
  - radial fossa
  - Capitulum (ball-shaped)
- **Distal component: radius**
  - superior aspect of the radial head (fovea) (cup-shaped)
- **joint type**
  - Limited ball-and-socket joint
- **motion :**
  - elbow flexion/ extension and forearm pronation/ supination

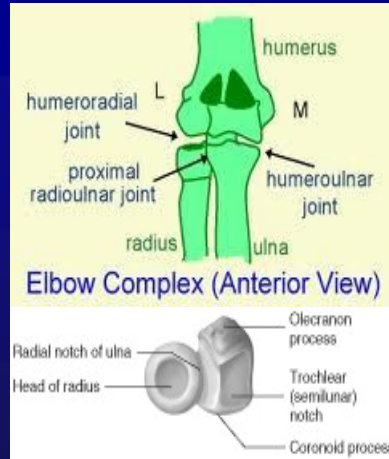


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## Proximal radioulnar joint

- **Proximal component : Ulna**
  - concave radial notch of the ulna
  - distal radius rotates around distal ulna.
- **Distal component : Radius**
  - convex rim of the radial head
  - radial head rotates around at proximal ulna.
- **Joint type**
  - pivot joint
- **Motion:**
  - forearm pronation/ supination
- **Annular ligament** maintains radial head in its joint.

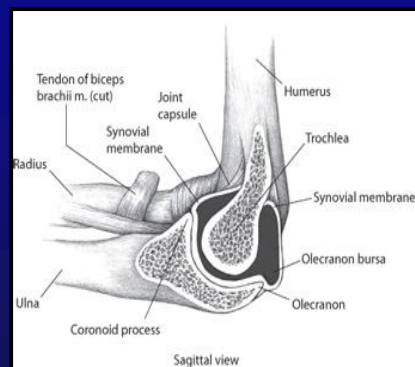


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## Elbow joints complex

- As elbow flexes 20 degrees or more, its bony stability is unlocked, allowing for more side-to-side laxity
- Stability in flexion is more dependent on:
  - Lateral (radial collateral ligament) &
  - Medial or (ulnar collateral ligament).

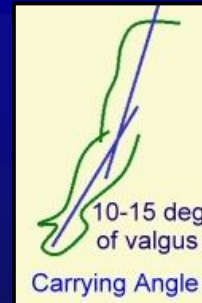


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## Carrying angle (cubitus angle)

- 5 degrees (in men) and 10-15° (in women) valgus angle when the elbow is fully extended and the forearm is fully supinated.
- Disappear when the elbow is extended and the forearm is pronated.
- Decreased when the elbow is flexed.
- female > male
- The trochlea of the humerus extends further distally than does the capitulum.
- The outer lip of the trochlea extends further distally than does the inner lip.
- Anomaly: - cubitus valgus i.e. cubitus angle >15°, resulting the forearm deviating outwards.
  - cubitus varus resulting the forearm deviating towards the midline.

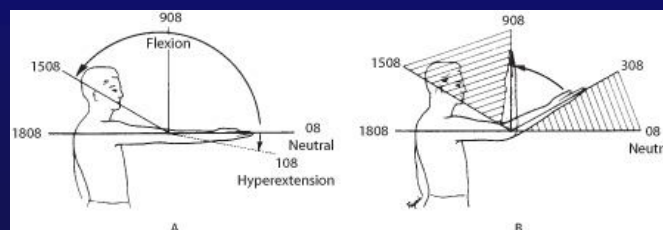


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## Elbow joint kinematics Elbow flexion and extension

- **Elbow moves from:** 0 degrees of extension to 145 to 150 degrees of flexion
- **Joint involved:**
  - humeroulnar joint (principal joint)
  - humeroradial joint
- **Plane of motion :** Sagittal plane



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## Movements at elbow complex

- Flexion
  - movement of forearm to shoulder by bending the elbow to decrease its angle
- Extension
  - movement of forearm away from shoulder by straightening the elbow to increase its angle

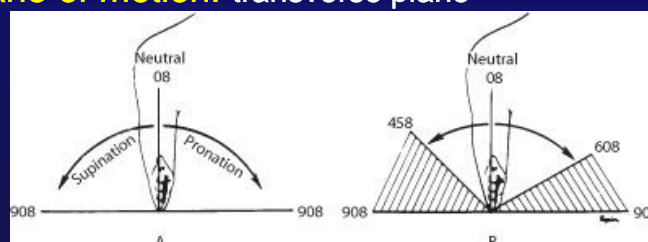


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## Radioulnar Joint kinematics Forearm pronation and supination

- Radioulnar joint:
  - Supinate 80 to 90 degrees from neutral
  - Pronate 70 to 90 degrees from neutral
- Joint involved:
  - proximal radioulnar joint
  - distal radioulnar joint
  - humeroradial joint
- Plane of motion: transverse plane

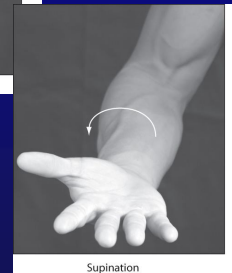
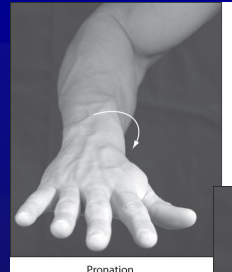


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## Movements at elbow complex (cont)

- Pronation
  - internal rotary movement of radius on ulna that results in hand moving from palm-up to palm-down position
- Supination
  - external rotary movement of radius on ulna that results in hand moving from palm-down to palm-up position



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## Joints Synergy

- Synergy between glenohumeral, elbow, & radioulnar joint muscles
  - As the radioulnar joint goes through its ROM, glenohumeral & elbow muscles contract to stabilize or assist in the effectiveness of movement at the radioulnar joints
  - Ex. when tightening a screw with a screwdriver which involves radioulnar supination, we tend to externally rotate & flex the glenohumeral & elbow joints, respectfully
  - Conversely, when loosening a tight screw with pronation, we tend to internally rotate & extend the elbow & glenohumeral joints, respectfully.

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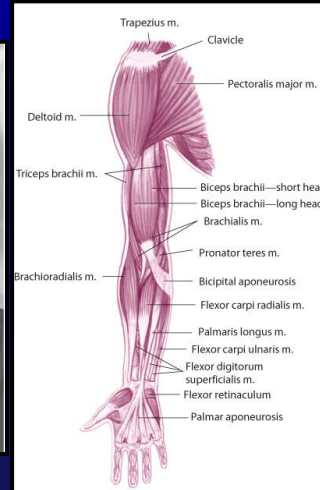
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## Muscles at Elbow complex

### • Anterior

- Primarily flexion & pronation
  - Biceps brachii
  - Brachialis
  - Brachioradialis
  - Pronator teres
  - Pronator quadratus (Weak assistance)
- Ex. Weight lifting (Biceps brachii, Brachialis & Brachioradialis)



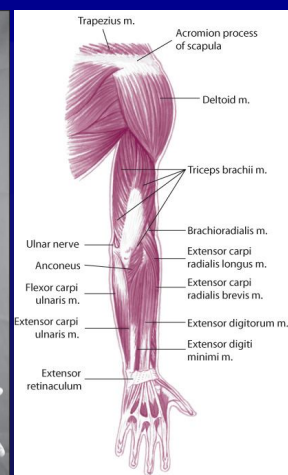
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## Muscles at Elbow complex

### • Posterior

- Primarily extension & supination
  - Triceps brachii
  - Anconeus (assistance)
  - Supinator
- Ex. Push-up (Triceps brachii & Anconeus)
- Tightening a screw (Supinator)



<http://www.getbodysmart.com/ap/muscularsystem/forearmmuscles/menu/menu.html>

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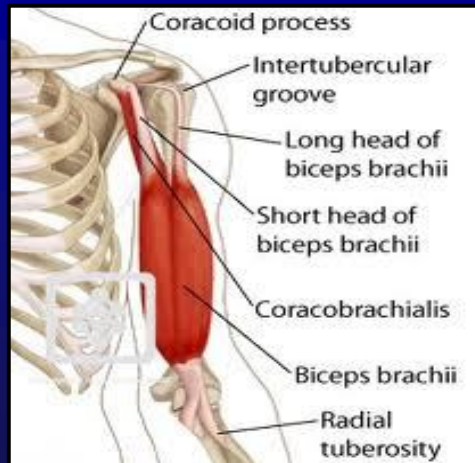
## Biceps Brachii Muscle

Flexion of elbow

Supination of forearm

Weak flexion of shoulder joint

Weak abduction of shoulder joint when externally rotated

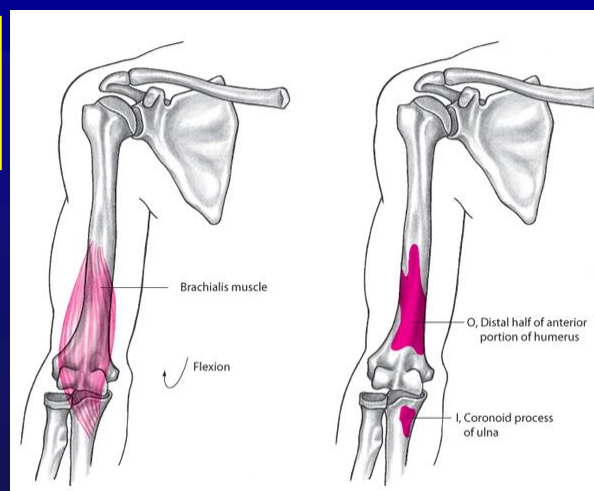


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## Brachialis Muscle

True flexion of elbow



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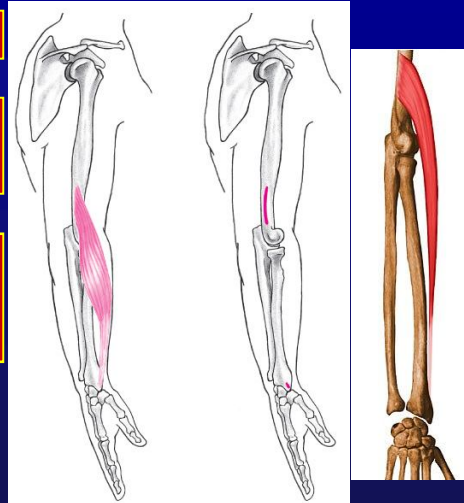
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## Brachioradialis Muscle

Flexion of elbow

Pronation from supinated position to neutral

Supination from pronated position to neutral



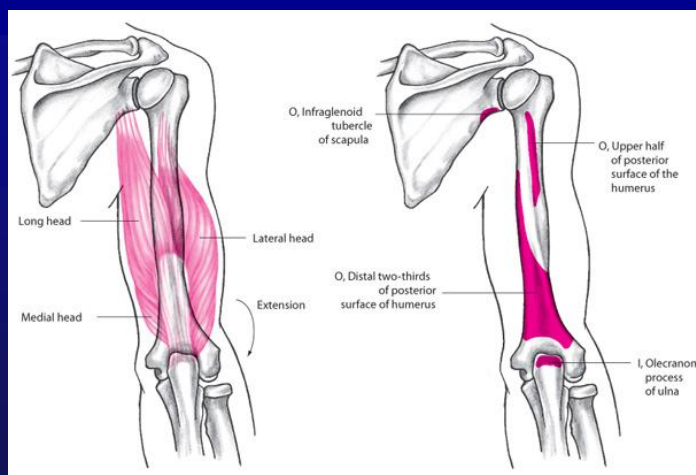
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## Triceps Brachii Muscle

All heads:  
extension  
of elbow

Long head:  
extension  
of shoulder  
joint;  
adduction  
of shoulder  
joint;  
horizontal  
abduction

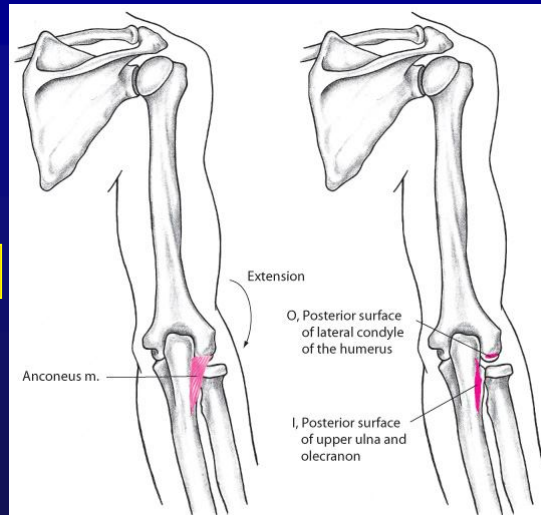


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## Anconeus Muscle

Extension of elbow



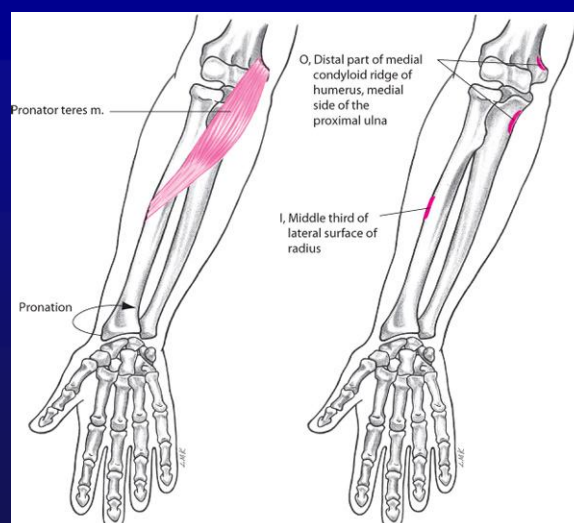
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## Pronator Teres Muscle

Pronation of forearm

Weak flexion of elbow

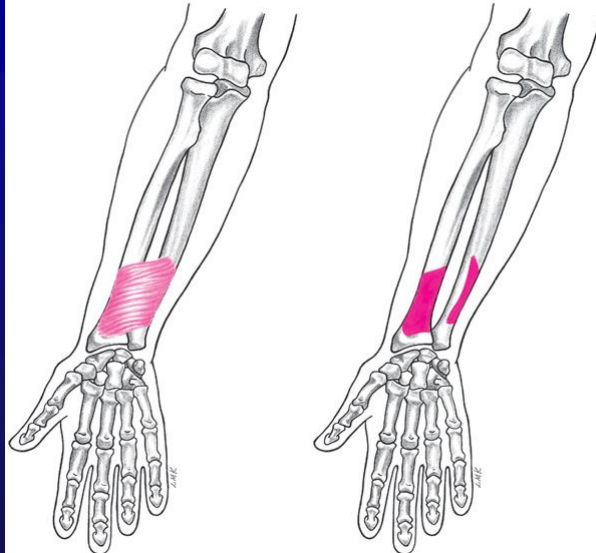


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## Pronator Quadratus Muscle

Pronation  
of  
forearm

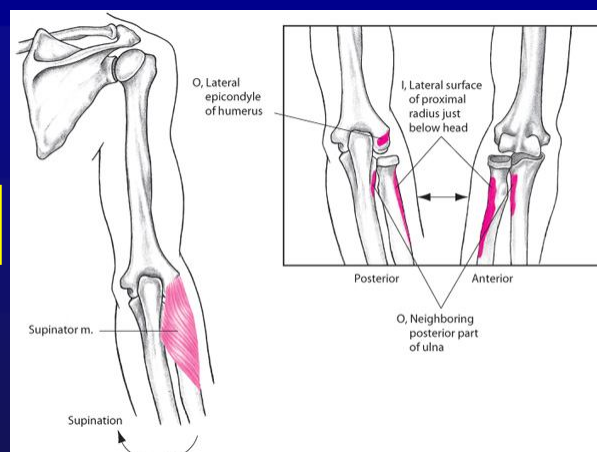


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## Supinator Muscle

Supination  
of  
forearm

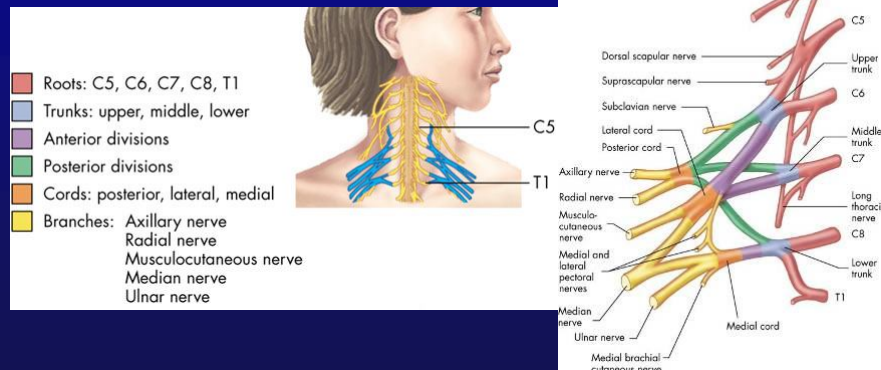


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## Nerves

- All elbow & radioulnar joints muscles are innervated from median, musculotaneous, & radial nerves of brachial plexus



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## Stability of the Elbow joints

- **Bony configuration:**
  - coronoid process prevents anterior displacement
  - olecranon process: prevents posterior displacement
  - humeroradial joint provides resistance to valgus stress
- **Tension of ligaments:**
  - **medial collateral ligament:**
    - against valgus stress
    - taut at full extension (anterior fibers) or full flexion (posterior fibers)
  - **lateral collateral ligament**
    - against varus stress
    - taut at full flexion
  - **anterior oblique ligament:**
    - preventing hyperextension
    - taut at extension
  - **posterior oblique ligament**
    - taut at flexion
    - less functional because its insertion is attached at the annular ligament
- **Muscle contraction (dynamic stability)**
  - anconeus : against varus stress
  - cocontraction of antagonists : to increase compression force and produce joint approximation.

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## Stability of the proximal radioulnar joint

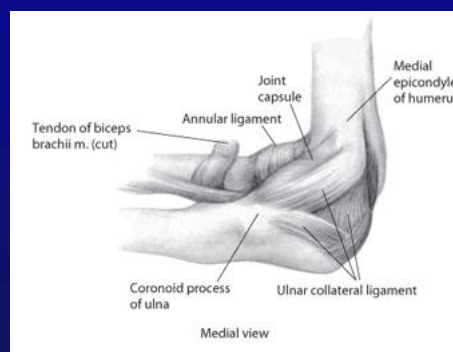
- **Tension of ligaments:**
  - **annular ligament** : against distraction of the radius and preventing dislocation of radial head
  - **inerosseous membrane**: prevents separation or longitudinal shift of radius and ulna.
- **Bony configuration:**
  - No benefit

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## Role of ligaments in the stability of the Elbow Complex

- Ulnar collateral ligament is critical in providing medial support to prevent elbow from abducting when stressed in physical activity
  - Many contact sports & throwing activities place stress on medial aspect of joint, resulting in injury

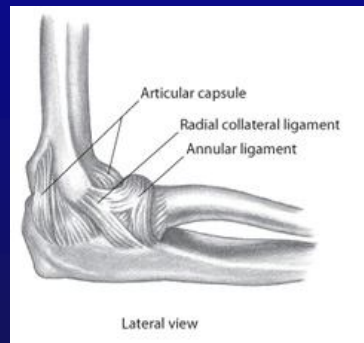


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## Role of ligaments in the stability of the Elbow Complex (cont)

- Radial collateral ligament provides lateral stability & is rarely injured
- Annular ligament provides a sling effect around radial head for stability



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## Mechanism of Injury at the Elbow

- **Direct stress**
  - Longitudinal compression stress: in fracture of radial head, coronoid or olecranon process and supracondylar fracture.
  - Distraction stress in nurse maid's elbow (pulled elbow)
  - Posterior stress as posterior dislocation of the elbow.
- **Repeated stresses**
  - Repeated wrist motions as forearm pronated e.g. repeated tensile stress on extensor carpi radialis brevis in case of tennis elbow (lateral epicondylitis)
  - Repeated wrist motions as forearm supinated e.g. repeated tensile stress on pronator teres, flexor carpi radialis in golfer's elbow

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## Common Muscles Injuries at the Elbow

- "Tennis elbow" - common problem usually involving extensor digitorum muscle near its origin on lateral epicondyle
  - known lateral epicondylitis
  - associated with gripping & lifting activities
- Medial epicondylitis
  - somewhat less common
  - known as golfer's elbow
  - associated with medial wrist flexor & pronator group near their origin on medial epicondyle
  - Both conditions involve muscles which cross elbow but act primarily on wrist & hand

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<http://moon.ouhsc.edu/dthompso/namics/elbow.htm>  
– Describes motions caused by the muscles.
- Huei Ming Chai**  
[www.pt.ntu.edu.tw/hmchai/Kines04/KINupper/Elbow.htm](http://www.pt.ntu.edu.tw/hmchai/Kines04/KINupper/Elbow.htm)  
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  - <http://www.getbodysmart.com/ap/muscularsystem/forearmmuscles/menu/menu.html>
  - <http://www.rad.washington.edu/academics/academic-sections/msk/muscle-atlas/upper-body/>

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